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AEROTECHNICAL DEVELOPMENT AND PATTERN OF TERTIARY EDUCATION ENVISAGED FOR 21ST CENTURY CHINESE AVIATION

ABSTRACT

Tertiary education in Chinese aviation began half a century ago, and ever since then Civil Aviation University of China (CAUC) has been the institution that trains aviation-oriented engineers and technicians, business administrators and researchers. Today, the majority of policy makers, and managerial and technical personnel within the industry have graduated from CAUC. The university features prominently in the modernization process of the industry, and its pedagogic philosophy has a profound influence on the industry's course of development.

We have been making constant efforts to find out a suitable pattern of education to civil aviation, summing up our own experience and drawing upon those of foreign institutions. Now a distinctive pattern has taken shape, characterized by appropriate training objectives and strategies to civil aviation, with the emphasis put on the cultivation of a safety consciousness, a stringent style of work, a spirit of coordination, practical skills and capabilities to adapt to new changes in aviation technology. Last year, the university was accredited by a national university standard assessing body authorized by the Chinese Ministry of Education.

Now, the bell of the new millennium is beginning to impinge on our ear, as on everybody else's. In face of the coming century, what conception of education quality should we adopt in light of the development trend of aviation technology and economy and the

general course China's tertiary education reform is taking?

FEATURES OF 21ST CENTURY AVIATION TECHNOLOGY AND AIRLINE ECONOMY

1. Knowledge Economy as a Prominent Feature

Civil aviation has always been dependent on the advance of science and technology for further growth. It is apparently impressed with the mark of knowledge economy, and this feature will become all the more prominent in the coming century. It incorporates all the mature and advanced modern technologies, and hence the ever more frequent renewals of aviation products and the striking innovations. For example, it took more than half a century for the servo-assisted gyro stabilization idea to effect the first stage of automation on aircraft, but within 10 years of the appearance of transistor technology, the second stage of automation was there. During the 80s, with the application of glass cockpit technique, civil aviation entered the third stage of automation. The same is true for the ground systems. The traditional air traffic control system had not yet to be brought to perfection in China, when FANS, based on satellite communication and navigation techniques, was adopted by developed countries. Likewise, aircraft maintenance is now going through a transition from the empirical to the scientific, and from passively carrying out orders to independently making decisions. This in-depth transition challenges the knowledge and capabilities of maintenance men. Aviation technicians must adapt themselves to these changes by broadening their domains of specialization, for otherwise they would find it hard to grasp and trouble-shoot the new generation of aircraft systems.

2. Distinct Features of Optimized Macro-systems

Modern development embodies a macro-conception of science and technology. Civil aviation, a high-tech intensive industry, will inevitably go systematized, unified and even globalized. For decades, the integral parts of the ever growing industry system have become more and more closely interconnected. Put in the context of digitalization technique, this feature becomes more obvious.

As regards ground service, the new generation of air traffic management has put aviation into a network, and satellite communication and navigation technique will have it globalized. Aviation activities are no longer isolated events but are related to the whole nation or even the whole world. The safe operation and the economic benefit of a single flight must be considered in terms of that of the whole company and the entire national airline industry. Macro-systematization is a necessary trend for ground service.

It is the same with airlines. With deregulation coming into effect in America in 1978, the 123 American companies operating scheduled flights were quickly reduced to 3, which are American Airlines, Delta Airlines and United Airlines. The victors set up their hubs of route networks, equipped themselves with advanced information management systems, and with effective marketing strategies, built themselves into optimized macro-systems with a powerful competitive edge. Modern world-famous airlines not only are big in scale, but have realized integrate management and system optimization.

3. A Man-centered Pattern Gradually Taking Shape

In the history of civil aviation, human factor science, since it was born in the 60s, has been propelled forward by every significant aviation-related project of research. In connection with reliability and maintainability design of technical equipment, it is becoming

more and more important in securing flight safety. Today, its research scope has extended from local and particular problems to problems affecting the whole situation, thus giving birth to a man-centered man-machine-environment system engineering. Man has a unique ability to analyze the condition of a macro-system, detect problems and correct errors. No automaton can replace man in handling dodgy complexities. In view of the complex macro-system where abstract thinking is required in dealing with fuzzy parameters and other complicated problems, a man in a passive state would be hard put to it to secure safety and economic benefit, as has been attested by numerous air accidents. Modern engineering especially favors humanization of technology, namely, design for man, design by man and design to facilitate man's execution. In a report, *21st Century Aircraft Technology*, jointly submitted by a few American institutions, they envisage a man-centered type of automation for the air transport system by 2020.

The aircraft has developed into a third stage of automation marked by glass cockpit and fly-by-wire. It can be predicted that 21st century aviation will realize on-board aero navigation, aircraft positioning and collision avoidance. A higher level of aircraft automation will be born of intelligent internal system management, with built-in diagnosing capability. Management and maintenance of this macro-system will be the responsibility of engineers and technicians and cockpit and managerial personnel.

With the technique of satellite communication, navigation and surveillance becoming full-fledged, traditional air traffic control will be superseded by air traffic management, and route separation, by aircraft separation, which will ultimately lead to free flying. The future aeronautical system will be capable of transmitting real-time ambient

data and realize aircraft positioning and navigation by means of a global aeronautical satellite system. Automatic surveillance and 4-D traffic management will make possible automatic management of central air traffic flow. Management and maintenance of this macro-system will be the responsibility of people in charge of navigation and communication.

Airlines, airports, aircraft supplies companies and aviation fuel companies will also be more concerned with man. Aircraft and air traffic management, operators, and aviation-related enterprises will all of them make extensive use of the computer network systems, such as the flight operation real-time dynamic management system and the decision-supporting system. These systems will make for scientific safety control. The use of market tracking and combined benefit analyzing systems will put airline operation on a scientific basis. Management and maintenance of these systems will be the responsibility of managerial and maintenance personnel.

REQUIREMENTS FOR AVIATION PERSONNEL IN 21ST CENTURY CHINESE AVIATION

1. Adapting to new aerotechnical development

Chinese aviation has been growing at a rate of 14.4% since 1995, with an increase of 240 passenger and cargo planes and 200 for general use. 41 large and medium-sized airports have been built or enlarged. Air traffic control is to international standards, and is undergoing a technical transition towards FANS. China's aircraft maintenance, with the stress on reliability and constant improvement on troubleshooting techniques, is reaching a world level, thus putting safety and economic benefit of Chinese aviation on a par with advanced world standards.

Aviation people must be capable of adapting to new aerotechnological development. They must have the ability to study on their own and receive continuing education. With the rapid development of science and technology, knowledge obsolescence cycle is shortening, renewals of equipment and manufactured products ever more frequent, and appearance of new domains of specialization more constant. As Price pointed out, research achievement for the first half of the 20th century by far surpassed that for the 19th century, and inventions and discoveries made since the 60s exceeded the totality for the previous 2000 years. On the one hand, this situation is putting out of work those who cannot update themselves, and on the other, the appearance of new fields of specialization provides job opportunities for those who are good at receiving new knowledge. It is reported that Americans switch jobs 12 times on an average in their lives, i.e., they change their jobs every 5 years. The traditional mode of work in Chinese Aviation has been discarded, and in its place new information-dependent work posts keep appearing. Therefore, aviation people must have the ability to improve themselves through continuing education and "life-long education". Only in this way can they adjust themselves to these social and technological changes.

2. Possessing good comprehensive qualities

Knowledge economy is replete with competition and creation. To adapt oneself to such a society, one must be knowledgeable and physically, psychologically sound to be able to find one's own niche.

Approximately speaking, comprehensive qualities for an aviation man include morality, health, psyche and techniques. By morality we mean that an aviation man must be faithful to his post and have a sense of social responsibility, and he must be honest, cooperative, courageous, creative, strict with himself, aware of his task and devoted to the cause of civil

aviation. By techniques we mean that an aviation man must possess profound knowledge on his job, he must have the ability of analysis and generalization, the ability of organization and management, the ability of creative thinking, and he must have an acute sense of observation. By health and psyche we mean that an aviation man must be sound in his mind and body. He must be able to bear hardships and to overcome and setbacks any difficulties. At present, humanism is an important aspect of the comprehensive qualities one should possess. It has penetrated into modern technology and industry, and so it is an internal driving force in civil aviation. Implicit in the combination of technology and economy is the combination of science and humanities, which requires of technical people a broad foundation of knowledge of the liberal arts and natural science as well as of technological knowledge. They are expected to be able to cope with political doctrines, moral standards and interpersonal relations. They should have the ability of social communication, management as well as coordination judgement.

3. Possessing the ability of creation

Creation is the soul of a nation. Mankind has stepped into an age when new branches of science are constantly emerging and the frontiers of the old are being pushed farther onwards, and computer application is more and more extensive. This is an age for men with creative power.

China is yet a developing country, Chinese aviation still has a long way to go to catch up with those of advanced countries in terms of science, technology, management and economic benefit. In order to turn China from a “big” aviation country into an aviation power, a

large number of creative talents are needed. They will play a decisive role in accelerating its aerotechnological and economic development, thus narrowing the gap between China and developed countries. In the coming 21st century when international competition on the economic front will become more and more fierce, a sense of creation will be the key to winning. This is true of an industry as well as of a nation. In fact, many economic powers have been setting about technological reforms to face the challenge of technological revolution since 1980s. For example, the 2061 plan drawn up by an American institution, and a report in Japan on the consultation about qualifications of engineers and technicians, both of them defined modern engineering and technology as creation or invention. So creative power is the most important quality of aviation men in the 21st century.

4. Possessing the concept of systematic engineering

For a long time, technical personnel have been required to be technicians or experts in a special field. But this mode is only suitable for planned economy, in which students majoring in mechanism are destined to be life-long mechanics while those majoring in electricity are destined to be electricians, with no need of knowing things like cost, price and the relationship between supply and demand. With the establishment of socialist market economy, people with too narrow a range of knowledge will be a misfit in the changing industry. The 21st century Chinese aviation needs people with a broader foundation of knowledge, who are the “systematic engineering” type of men, having knowledge

of mechanical electricity, computer, economic analysis and management. The coming new century particularly favors those who are versed both in technical skills and in management. Those who content themselves with proficiency in a particular line will be rejected. Too much stress on specialization will be given up in favor of integrity of an engineering system. Technical personnel should be conscious of the social and economic environment and the international background relevant to their technical work, so as to be good managers, planners and policy-makers. This is exactly the university's urgent task in the education reform.

The 21st century CAUC will be a cradle of creative talents, an explorer of truth and the unknown world, the outpost of research providing scientific bases for solutions to important problems in Chinese aviation, the agency to turn research achievement into productive forces. We will inherit our fine traditions, and learn the advanced techniques of the world, We will have to strengthen exchange and cooperation with our colleagues the world over.

My dear friends, a new up-to-date campus area of our university is about to come into use. I hereby welcome you to our university for a visit.

